REMARKS

The Examiner is thanked for the due consideration given the application. This Amendment is being filed concurrently with a Request for Continued Examination.

Claims 12-20 and 22-26 are pending in the application. Support for the amended claim set can be found in paragraphs [0024] and [0033] of the corresponding U.S. Publication.

No new matter is believed to be added to the application by this amendment.

Request for Interview

The Examiner is respectfully requested to contact the Applicant’s representative (Robert E. Goozner) at telephone number (703) 521-2297 in order to arrange an interview to discuss the patentability of the present invention.

Rejections Under 35 USC §103(a)

Claims 12-14, 16-20 and 22-26 have been rejected under 35 USC §103(a) as being unpatentable over TAMURA et al. (*14th Annual Meeting of the IEEE*, Vol. 1, 12-13 Nov. 2001, pp.97-98) in view of LEDENTSOV et al. (U.S. Publication 2003/0206741). Claim 15 has been rejected under 35 USC §103(a) as being unpatentable over TAMURA et al. in view of LEDENTSOV et al., and further in view of KAMIOKA et al. (JP 2001-024289). These rejections are respectfully traversed.

The present invention pertains to a modulator-integrated light source that operates over a wide temperature

range. The modulator-integrated light source of the present invention is illustrated, by way of example, in Figure 2A of the application, which is reproduced below.

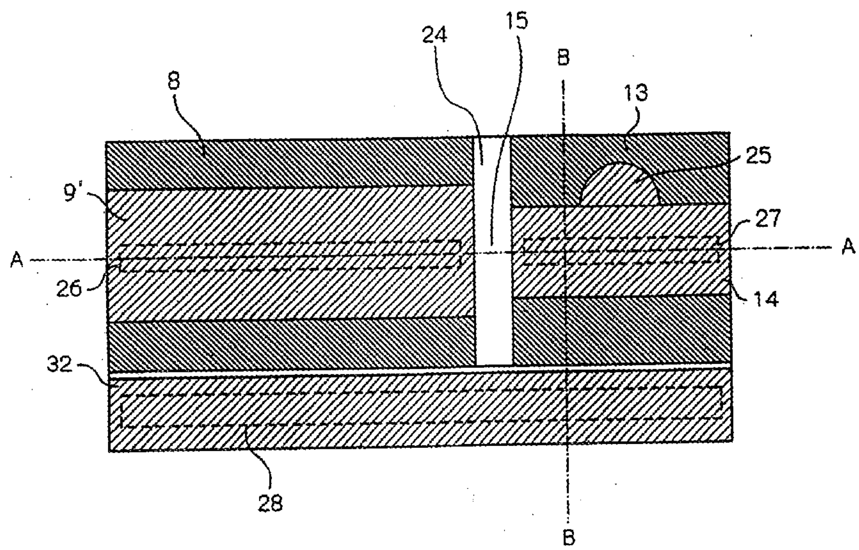


Figure 2A shows a p electrode 14, an n electrode 32 and contact windows 26 and 28. An electrode separator 15 and SiO_2 film 24 divide the p electrode 14.

The electroabsorption of the optical modulator of the present invention satisfies the condition "*$L \times B \geq 2000$ µm • Gb/s where L is a length of said electroabsorption optical modulator and B is an operating frequency,*" as is set forth in claim 12 of the present invention. Claim 12 of the present invention also optimizes (that is, eliminates) temperature effects by setting the energy conversion value ΔX of a detuning amount to be "*40 meV $\leq \Delta X \leq$ 100 meV.*"

Independent claim 12 (and claim 22) of the present invention now recite that the light soure includes: "*a feedback*

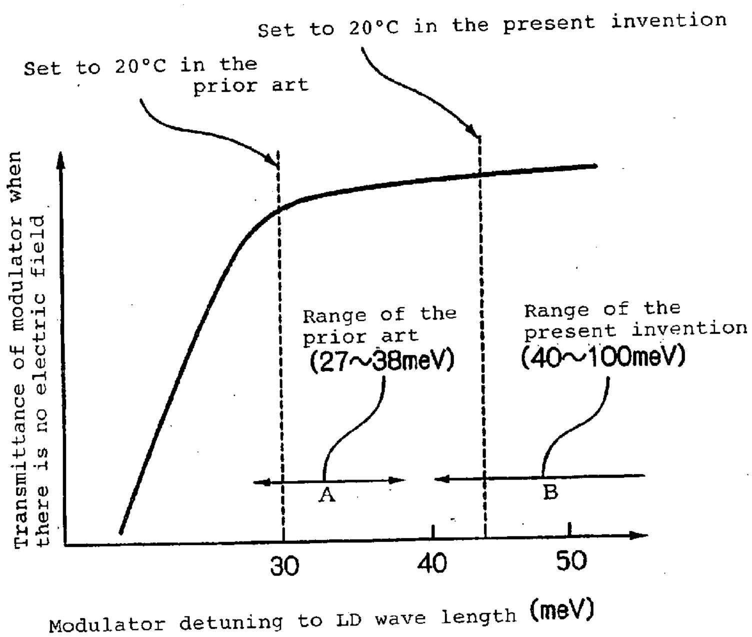
circuit which monitors an element temperature and which increases an offset voltage according to decreases in temperature and in which a semiconductor laser and an electroabsorption optical modulator are integrated on a high resistance semiconductor substrate."

Distinctions of the present invention over the cited art references have been made of record in the application. For brevity, these discussions are not repeated here.

However, it is additionally noted that, as has been noted by the examiner, LEDENTSOV et al. describe a detuning range of 40 meV or greater and 100 meV or less. However, the application of the detuning range, described in LEDENTSOV et al., to the present invention would not occur to those skilled in the art.

The reasons for this include that LEDENTSOV et al. has a configuration for variable wavlength using the alteration in the refractive index and does not assume the absorption of light. Since detuning can generally ignore the absorption of light at 40 meV or greater (as illustrated in a flat portion of Figure 4 of the present invention, reproduced below), the configuration of the cited invention of LEDENTSOV et al., in which detuning is set to the amount of 40 meV or greater and 100 meV or less and in which only the alteration in the refractive index will be used, is commonly practiced.

[Fig.4]



Now consider the present invention.

The basis of an electroabsorption modulator of the present invention is to change light into an absorbent state by making use of the technical concept in which application of a (reverse bias) voltage makes the detuning smaller and extinguishes the light.

Consequently, when no voltage is applied (at the time of 0 V), detuning is generally set at a marginal point (27 meV to 38 meV in Figure 4, above) where no light is absorbed. Such setting changes light into an absorbent state when a voltage is applied (as the detuning becomes, for example, 20 meV or less).

There is a disincentive element that causes the detuning range of LEDENTSOV et al. not to be used in an

electroabsorption modulator in the past.

That is, the use of the detuning amount (40 meV or greater) that is away from the region in which light is absorbed (which is a region where the detuning becomes smaller = the left region of Figure 4 of the present invention) for the electroabsorption modulator that must use the absorption of light actively was preferably avoided.

There are significant reasons why the present invention can use the detuning amount that was not used in the electroabsorption modulator in the past.

A reason for using the detuning amount of 40 meV or greater and 100 meV or less in the present invention resides in that there is another parameter that controls the detuning of the electroabsorption modulator, which is temperature. It is generally known that when temperature increases, detuning becomes smaller. Then, even in the case where the default detuning setting is 40 meV or greater, the detuning range can be set to a conventional range (i.e., 27 meV to 38 meV) if the temperature increases.

In addition to temperature, by also adjusting the offset voltage, it is possible to adjust the detuning in a wide range. Consequently, in the wide range of the default setting of the detuning at 40 meV to 100, the constitution of the present invention can be used as an absorption type modulator.

Such a method for adjusting the detuning according to

two parameters of temperature and offset voltage is disclosed in the applied art. However, the prior art does not disclose the detuning range of 40 meV to 100 meV of the present invention.

In the case where only the constitution as described above is used, a problem arises when temperature decreases. A solution will be explained below.

Since detuning becomes greater when temperature decreases, it naturally becomes necessary to make the offset voltage (in the reverse bias direction) greater.

As a construction for realizing a modulator that does not require a driver, which is the objective of the present application, the length of the modulator L must be lengthened. The reason why the voltage decreases when L is lengthened is that, if the absorption rate α (cm^{-1}) of light per unit length is considered to be generally proportional to the voltage and if the necessary absorption amount is obtained by multiplying a by L, and if L is lengthened, α, which is the voltage, will be inversely proportional to L.

Ordinarily, when the modulator length L is lengthened, the electrostatic capacitance C proportionally increases. This is because the area of the modulator, which is obtained by multiplying the width of a waveguide by the length of modulator L, increases proportionally to L and C is proportional to the area. Ordinarily, if the electrostatic capacitance C increases, the operating speed B of the modulator (bit/s) decreases. This is

because the operating speed is inversely proportional to resistance R x the electrostatic capacitance C (RC limit).

Therefore, the electrostatic capacitance C needs to be lowered. One end of a parallel flat plate configuring the electrostatic capacitance C is a metal electrode positioned immediately above the modulator, and the other end is an electrode on the reverse side. However, since ordinary semiconductor substrates that have low electric resistivity are used, the electrode on the reverse side through which current flows into the upper part of the semiconductor substrates, and the distance between electrodes that decides the electrostatic capacitance C is just a few microns.

Then, the reason for using a high-resistance substrate in the present invention resides in that a constitution, that causes the capacitance not to be generated by using a high-resistance semiconductor substrate and by positioning the reverse side electrode on the side of the waveguide, can be realized.

That the use of a high resistance substrate for the electroabsorption modulator is, as described in the cited invention of TAMURA, ordinarily limited to a high-speed modulator of 40 Gbps or greater is common sense, and no report is made for a case of a modulator of 10 Gbp or greater and less than 40 Gbp.

However, that the use of a high-resistance substrate is effective for satisfying both the operation, which occurs in a temperature range that is not uniform, and the low offset voltage

has, as described in the present application, not been considered in the past.

Further, if L is lengthened, not only will the offset voltage be lowered but also, proportionally, the modulation voltage amplitude will be lowered concurrently. Consequently, it is known that it is possible to operate under 1 V or less.

Conclusion

To set the detuning amount at 40 meV or greater and 100 meV or less in the structure described in LEDENTSOV et al. is general. However, in the electroabsorption modulator of the present invention, there exists a disincentive element to set the detuning amount at 40 meV or greater and 100 meV or less, and adopting the detuning amount of such range was avoided.

According to the elements described in claims 12 and 22, by using the detuning range that was not used in the electroabsorption modulator, light can be sufficiently absorbed even in high-temperature or low-temperature condition without prejudicing low-voltage operation.

Therefore, the structure described in the cited invention of LEDENTSOV et al. and the structure of the present invention are totally different in terms of the structure and the operational basis, and that replacement of the detuning between those structures will not occur to those skilled in the art. On the contrary, replacement would occur to those skilled in the art as being disincentive.

The present invention is accordingly the first invention that realizes a detuning amount that has such a range.

One of ordinary skill in the art would thus fail to produce independent claim 12 or 22 of the present invention from a knowledge of TAMURA et al. and LEDENTSOV et al. (and KAMIOKA et al.) A *prima facie* case of unpatentability has thus not been made. Claims depending upon claim 12 are patentable for at least the above reasons.

Further, the present invention shows unexpected results that would fully rebut any unpatentability that could be alleged. These unexpected results include modulator detuning to greater wavelength (meV) that has been discussed above and in the last response.

The advantages of the present invention over the applied art are thus clear.

These rejections are believed to be overcome, and withdrawal thereof is respectfully requested.

Conclusion

The Examiner is thanked for considering the Information Disclosure Statement filed August 18, 2006 and for making an initialed PTO-1449 Form of record in the application.

Prior art of record but not utilized is believed to be non-pertinent to the instant claims.

It is believed that the rejections have been overcome, obviated or rendered moot and that no issues remain. The Examiner

is accordingly respectfully requested to place the application in condition for allowance and to issue a Notice of Allowability.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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